Locality Domains and Phonological C-Command Over Strings

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You can get the slides here under "News"

Take-Home Message

A cross-module restriction on well-formedness conditions:

Domain	Phonology	Syntax
bounded	intervocalic voicing	subcategorization
unbounded	sibilant harmony	movement
b + **u**	non-final RHOL	c-command
b + **u** + **b**	*first-last harmony	*sibling of c-commandee

The Main Conjecture: Ban on Improper Locality

Once unbounded, always unbounded.

This talk is mostly about the **phonology** column.
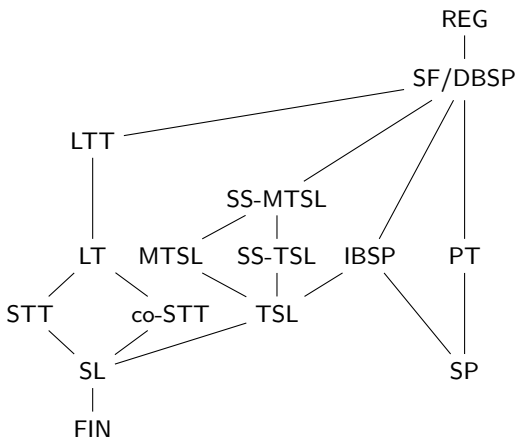
Methodology

- ► Only **phonotactics** considered (no input-output mappings)
- ► **Subregular** phonology as measuring rod for complexity
  (Heinz 2009, 2010; Heinz et al. 2011; Chandlee 2014; Jardine 2016;
  McMullin 2016; Graf 2017)

1 define different
  classes of
  grammars

2 organize these
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  expressivity
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3 needed level of
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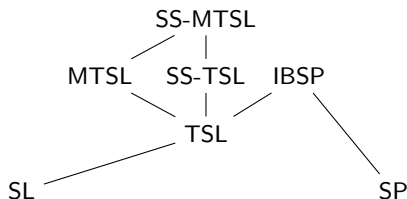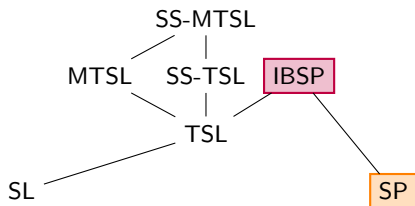 McMullin 2016; Graf 2017)

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```
                      SS-MTSL
                         |
           MTSL     SS-TSL     IBSP
                \    |    /
                   TSL
                 /         \
            SL                   SP
```

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|
MTSL   SS-TSL   IBSP
|
TSL

SL

SP

Outline

Unbounded Phenomena in Phonology

1 **Samala Sibilant Harmony**
Sibilants must not disagree in anteriority.
(Applegate 1972)

    (1)   a.   * ha**s**xintilawa∫

           b.   * ha∫xintilawa**s**

           c.   ha∫xintilawa∫

2 **Unbounded Tone Plateauing in Luganda** (UTP)
No L may occur within an interval spanned by H.
(Hyman 2011)

    (2)   a.   **L**H**LLLLL**

           b.   **LLLLL**H**L**

           c.   * **L**H**LLL**H**L**

           d.   **L**HHHHH**L**

Strictly Piecewise Dependencies

▶ Each phenomenon can be represented by a collection of
finitely many **forbidden subsequences**.

Phenomenon	Constraint	Forbidden Subsequences
Sibilant harmony	*$[\alpha$ ant$]\cdots[-\alpha$ ant$]$	s∫ , ∫s
UTP	*HLH	HLH

▶ A well-formedness condition is **strictly piecewise (SP)** iff
it is equivalent to a finite list of forbidden subsequences.

Blocking Effects are Beyond SP

- ▶ SP conditions have no notion of locality at all.
- ▶ Blocking is a simple form of locality, and hence beyond SP.

Latin L-Dissimilation (Simplified; (Stanton 2016))

- ▶ /l/ in morpheme /-alis/ becomes /r/ if stem contains /l/

    (3)   a. * lupanalis

            b.   lupanaris

- ▶ blocked by intervening /r/

    (4)   a.   fulguralis

            b. * fulguraris

- ▶ **Problem for SP**: forbidding l···l for (3a) also rules out (4a)

Locality Domains are Beyond SP

- There is also a problem with the SP account of UTP.
- *H $\cdots$ L $\cdots$ H bans any L between H, no matter what.
- But tone processes are known to also apply across words.
- Unless we limit representations to single words,
  *H $\cdots$ L $\cdots$ H overapplies.

(5)   a.   * LHLLLHLL
       b.   LHL$LHLL

- The word boundary $ should block tone plateauing,
  but blocking effects are not SP.

SP + Locality = IBSP

- ▶ The central problem of SP is the lack of locality domains.
- ▶ **Danger:** arbitrary domains push SP to DBSP ⇒ too powerful (Graf 2017)
- ▶ **Restricted version:** SP limited to specific intervals

Interval-Based Strictly Piecewise (IBSP)

1 Finite list of forbidden subsequences
2 Application domain, encoded as **k-val**

3-val for UTP

- ▶ Forbidden subsequence: *$\mathbf{H}$L$\mathbf{H}$
- ▶ Locality domain:
  - ▶ spans between two $\mathbf{\$}$,
  - ▶ and no other $\mathbf{\$}$ occurs between them.
- ▶ Represented as a 3-val:

3-val for UTP

- Forbidden subsequence: ***HLH**
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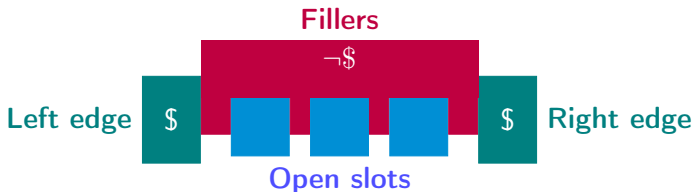- Represented as a 3-val:

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Left edge $ ¬$ $ **Right edge**

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Restricting *HLH with the k-Val

- *HLH applies only to segments in a matching interval

$$*\ \$\ \ L\ \ H\ \ L\ \ L\ \ L\ \ H\ \ L\ \ L\ \ \$$$

- If both H are in different words, the 3-val cannot match.

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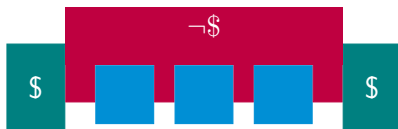

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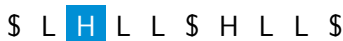- If both H are in different words, the 3-val cannot match.
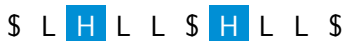
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R-Blocking for Latin L-Dissimilation

- ▶ A simple constraint: *l
- ▶ With a peculiar domain:

* $ l u p a n a l i s $

$ f u l g u r a l i s $

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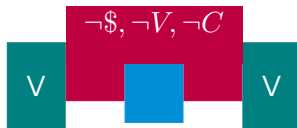
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Local Constraints are IBSP

- Local constraints are IBSP conditions without fillers.
- **Example:** intervocalic voicing
  - **Forbidden:** [-voiced]
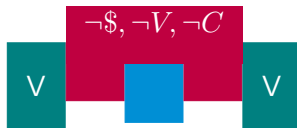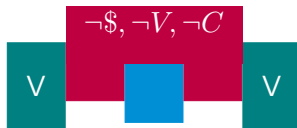 - **Domain:** between vowels, with no fillers

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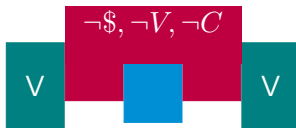 - **Domain:** between vowels, with no fillers

$$\neg\$, \neg V, \neg C$$

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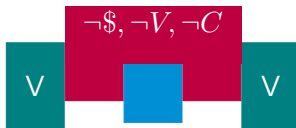 - **Domain:** between vowels, with no fillers

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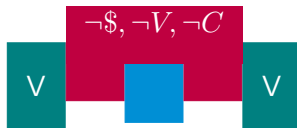

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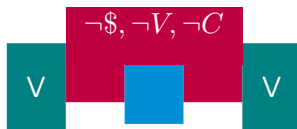

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V   V

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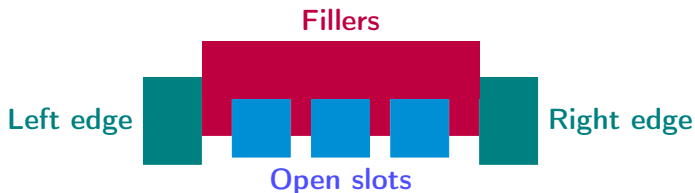 - ▶ **Domain:** between vowels, with no fillers

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Prediction: Local and Non-Local Do Not Mix

- All k-vals follow the same base template:

Fillers

Left edge   **Right edge**

Open slots

- To enforce adjacency, we have to ban all potential fillers.
- But without fillers, we get **adjacency across the board**!

- **IBSP Prediction:** Local and non-local do not mix.

Non-Local Local Phenomena Exist!

- ▶ The IBSP prediction is **false**!
- ▶ Some phenomena combine local and non-local information:
    1. non-local blocking of local dissimilation (Samala)
       (Applegate 1972; McMullin 2016)
    2. non-final RHOL (Eastern Cheremis, Dongolese Nubian)
       (Hayes 1995; Baek 2017)
    3. non-local trigger of ternary spreading (Copperbelt Bemba)
       (Bickmore and Kula 2013; Jardine 2016)
- ▶ **Conclusion:** IBSP needs a more fine-grained notion of k-val.

Non-Local Blocking of Local Dissimilation

1 **Local Dissimilation in Samala...**
   [sn], [sl], [st] are forbidden...

2 **...With Non-Local Blocking**
   ...unless there is another [s] later on in the same word

$$^* \$ \, s \, n \, a \, n \, ? \, \$$$
$$\$ \, s \, n \, e \, t \, u \, s \, \$$$

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   *l
   *t

                    * $ s n a n ʔ $
                      $ s n e t u s $

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Non-Final RHOL

1. Stress the rightmost non-final heavy syllable, if it exists.
2. Otherwise, stress the leftmost (=first) syllable.

$$* \ \$ \ \acute{L} \ L \ H \ H \ H \ \$$$
$$* \ \$ \ L \ \acute{L} \ H \ H \ H \ \$$$
$$* \ \$ \ L \ L \ \acute{H} \ H \ H \ \$$$
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$*$ÝHX
$*$XĹX
$*$XXÝ

(X $\in$ {H,L})

$*$ \$ Ĺ L H H H \$

$*$ \$ L Ĺ H H H \$

$*$ \$ L L Ĥ H H \$

$*$ \$ L L H H Ĥ \$

\$ L L H Ĥ H \$

15

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*XĹX
*XXẌ

$(X \in \{H,L\})$

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* $ L Ĺ H H H $

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* \$ L L H H H́ \$

   \$ L L H H́ H \$

Non-Final RHOL

1. Stress the rightmost non-final heavy syllable, if it exists.
2. Otherwise, stress the leftmost (=first) syllable.

*ẊHX
*XĹX
*XXẊ

$(X \in \{H,L\})$

* \$ Ĺ L H H H \$

* \$ L Ĺ H H H \$

* \$ L L Ḣ H H \$

* \$ L L H H Ḣ \$

\$ L L H Ḣ H \$

Non-Final RHOL

1 Stress the rightmost non-final heavy syllable, if it exists.
2 Otherwise, stress the leftmost (=first) syllable.

* X́HX
*XĹX
*XXX́

(X ∈ {H,L})

* \$ Ĺ L H H H \$
* \$ L Ĺ H H H \$
* \$ L L H́ H H \$
* \$ L L H H H́ \$
  \$ L L H H́ H \$

Non-Final RHOL

1. Stress the rightmost non-final heavy syllable, if it exists.
2. Otherwise, stress the leftmost (=first) syllable.

*ХHX
*XĹX
*XXХ

$(X \in \{H,L\})$

* $ Ĺ L H H H $

* $ L Ĺ H H H $

* $ L L Ń H H $

* $ L L H H Ń $

   $ L L H Ń H $

15

Non-Final RHOL

1 Stress the rightmost non-final heavy syllable, if it exists.

2 Otherwise, stress the leftmost (=first) syllable.

*ẂHX
*XĹX
*XXẂ

(X ∈ {H,L})

* \$ Ĺ L H H H \$

* \$ L Ĺ H H H \$

* \$ L L Ĥ H H \$

* \$ L L H H Ĥ \$

  \$ L L H Ĥ H \$

Non-Final RHOL

1. Stress the rightmost non-final heavy syllable, if it exists.
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*ẊHX
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Non-Final RHOL

1. Stress the rightmost non-final heavy syllable, if it exists.
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∗ X́HX
∗ XĹX
∗ XXX́

(X ∈ {H,L})

∗ $ Ĺ L H H H $

∗ $ L Ĺ H H H $

∗ $ L L H́ H H $

∗ $ L L H H H́ $

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(X ∈ {H,L})

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* $ L Ĺ H H H $

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(X ∈ {H,L})

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1 Stress the rightmost non-final heavy syllable, if it exists.

2 Otherwise, stress the leftmost (=first) syllable.

* X́HX
*XĹX
*XXX́

(X ∈ {H,L})

¬\$ none

\$ \$

* \$ Ĺ L H H H \$

* \$ L Ĺ H H H \$

* \$ L L H́ H H \$

* \$ L L H H H́ \$

  \$ L L H H́ H \$

15

Non-Final RHOL

1. Stress the rightmost non-final heavy syllable, if it exists.
2. Otherwise, stress the leftmost (=first) syllable.

*ŹHX
*XĹX
*XXŹ

(X ∈ {H,L})

* $ Ĺ L H H H $

* $ L Ĺ H H H $

* $ L L Ĥ H H $

* $ L L H H Ĥ $

$ L L H Ĥ H $

Non-Final RHOL

1 Stress the rightmost non-final heavy syllable, if it exists.

2 Otherwise, stress the leftmost (=first) syllable.

$*$ÝHX
$*$XĹX
$*$XXX́

(X $\in$ {H,L})

$*$ $\$$ Ĺ L L H H H $\$$

$*$ $\$$ L Ĺ H H H $\$$

$*$ $\$$ L L H́ H H $\$$

$*$ $\$$ L L H H H́ $\$$

$\$$ L L H H́ H $\$$

Non-Final RHOL

1. Stress the rightmost non-final heavy syllable, if it exists.
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*ḰHX
*XĹX
*XXḰ

$(X \in \{H,L\})$

* \$ Ĺ L L H H H \$

* \$ L L Ĺ H H H \$

* \$ L L L Ḱ H H \$

* \$ L L L H H Ḱ \$

\$ L L L H Ḱ H \$

Non-Final RHOL

1. Stress the rightmost non-final heavy syllable, if it exists.
2. Otherwise, stress the leftmost (=first) syllable.

*ẌHX
*XĹX
*XXẌ

(X ∈ {H,L})

* \$ Ĺ L L H H H \$
* \$ L Ĺ H H H \$
* \$ L L Ĥ H H \$
* \$ L L H H Ĥ \$
  \$ L L H Ĥ H \$

Non-Final RHOL

1. Stress the rightmost non-final heavy syllable, if it exists.
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*ẊHX
*XĹX
*XXẊ

(X ∈ {H,L})

* $ Ĺ L H H H $

* $ L Ĺ H H H $

* $ L L Ή H H $

* $ L L H H Ή $

$ L L H Ή H $

Non-Final RHOL

1. Stress the rightmost non-final heavy syllable, if it exists.
2. Otherwise, stress the leftmost (=first) syllable.

*X́HX
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*XXX́

(X ∈ {H,L})

¬$ none

$ $

* $ Ĺ L L H H H $
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* $ L L H H H́ $
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* $ L L H H H́ $

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1. Stress the rightmost non-final heavy syllable, if it exists.
2. Otherwise, stress the leftmost (=first) syllable.

$*$ÝHX
$*$XĹX
$*$XXÝ

(X ∈ {H,L})

$*$ \$ Ĺ L H H H \$

$*$ \$ L Ĺ H H H \$

$*$ \$ L L Ĺ H H \$

$*$ \$ L L H H Ĺ \$

\$ L L H Ĺ H \$

Non-Final RHOL

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*ÝHX
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*XXÝ

(X $\in$ {H,L})

* $ Ĺ L L H H H $

* $ L Ĺ H H H $

* $ L L Ĥ H H $

* $ L L H H Ĥ $

$ L L H Ĥ H $

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$(X \in \{H,L\})$

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2. Otherwise, stress the leftmost (=first) syllable.

*ḰHX
*XĹX
*XXΧ́

$(X \in \{H,L\})$

* $ Ĺ L H H H $
* $ L Ĺ H H H $
* $ L L Ḱ H H $
* $ L L H H Ḱ $
$ $ L L H Ḱ H $

15

Bounded Tone Spreading

1 **Unbounded Tone Spreading in Copper Belt Bemba...**
   H spreads all the way to the right edge,...

2 **...With a Non-Local Inhibitor**
   ...but only 2 syllables if there is an H later on.

$$^* \quad \$ \ H \ L \ L \ L \ L \ L \ H \ \$$$

$$^* \quad \$ \ H \ h \ L \ L \ L \ L \ H \ \$$$

$$^* \quad \$ \ H \ h \ h \ h \ h \ L \ H \ \$$$

$$^* \quad \$ \ H \ h \ h \ L \ h \ L \ H \ \$$$

$$\$ \ H \ h \ h \ L \ L \ L \ H \ \$$$

Bounded Tone Spreading

1 **Unbounded Tone Spreading in Copper Belt Bemba...**
   H spreads all the way to the right edge,...
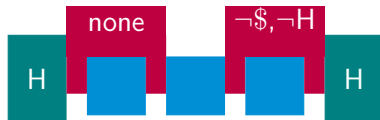**2** **...With a Non-Local Inhibitor**
   ...but only 2 syllables if there is an H later on.

$$^*LXX$$
$$^*XLX$$
$$^*hhh$$

$$(X \in \{H,L,h\})$$

* $ H L L L L L H $

* $ H h L L L L H $

* $ H h h h h L H $

* $ H h h L h L H $

$ H h h L L L H $

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*XLX
*hhh

$(X \in \{H,L,h\})$

* $ H L L L L L H $

* $ H h L L L L H $

* $ H h h h h L H $

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Bounded Tone Spreading

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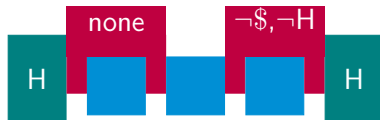H spreads all the way to the right edge,...
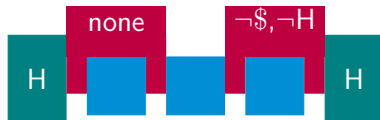
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*LXX
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(X $\in$ {H,L,h})

* \$ H L L L L L H \$

* \$ H h L L L L H \$

* \$ H h h h h h L H \$

* \$ H h h L h L H \$

\$ H h h L L L H \$

Bounded Tone Spreading

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H spreads all the way to the right edge,. . .
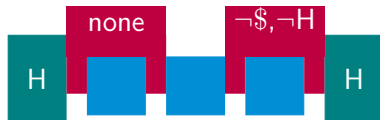
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*LXX
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(X ∈ {H,L,h})

* $ H L L L L L H $

* $ H h L L L L H $

* $ H h h h h L H $

* $ H h h L h L H $

  $ H h h L L L H $

16

Bounded Tone Spreading

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*LXX
*XLX
*hhh

(X ∈ {H,L,h})

```
* $ H L L L L L H $
* $ H h L L L L H $
* $ H h h h h h L H $
* $ H h h L h L H $
  $ H h h L L L H $
```

Bounded Tone Spreading

1 **Unbounded Tone Spreading in Copper Belt Bemba...**
H spreads all the way to the right edge,...

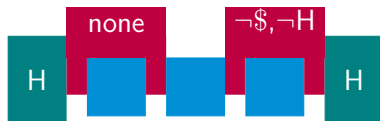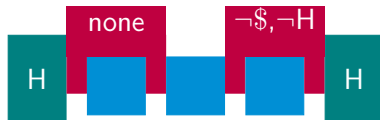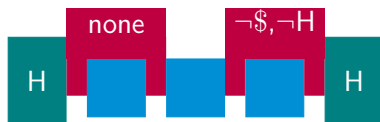**2** **...With a Non-Local Inhibitor**
...but only 2 syllables if there is an H later on.

*LXX
*XLX
*hhh

$(X \in \{H,L,h\})$

* \$ H L L L L L H \$
* \$ H h L L L L H \$
* \$ H h h h h h L H \$
* \$ H h h h L h L H \$
\$ H h h h L L L H \$

Bounded Tone Spreading

1. **Unbounded Tone Spreading in Copper Belt Bemba...**
   H spreads all the way to the right edge,...

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   ...but only 2 syllables if there is an H later on.

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(X ∈ {H,L,h})

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$(X \in \{H,L,h\})$

$*$ \$ H L L L L L H \$
$*$ \$ H h L L L L H \$
$*$ \$ H h h h h h L H \$
$*$ \$ H h h L h L H \$
   \$ H h h L L L H \$

16

Bounded Tone Spreading

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H spreads all the way to the right edge,...

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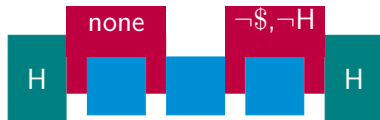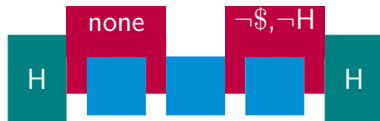...but only 2 syllables if there is an H later on.

*LXX
*XLX
*hhh

$(X \in \{H,L,h\})$

* \$ H L L L L L H \$
* \$ H h L L L L H \$
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16

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```
*  $  H  L  L  L  L  L  H  $
*  $  H  h  L  L  L  L  H  $
*  $  H  h  h  h  h  L  H  $
*  $  H  h  h  L  h  L  H  $
   $  H  h  h  L  L  L  H  $
```

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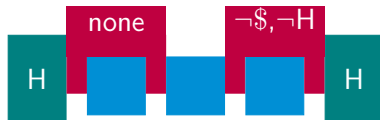
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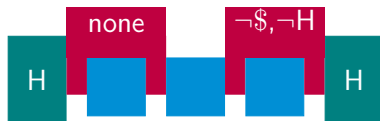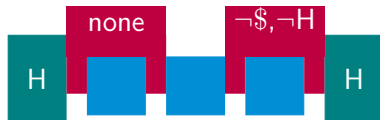. . .but only 2 syllables if there is an H later on.

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$(X \in \{H,L,h\})$


```
*  $  H  L  L  L  L  L  H  $
*  $  H  h  L  L  L  L  H  $
*  $  H  h  h  h  h  L  H  $
*  $  H  h  h  L  h  L  H  $
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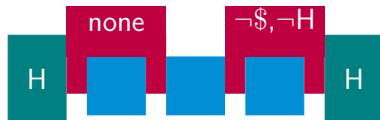   . . . but only 2 syllables if there is an H later on.

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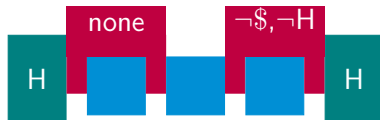**2** **...With a Non-Local Inhibitor**
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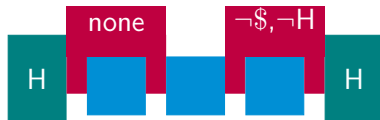
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*	$	H	L	L	L	L	L	H	$
*	$	H	h	L	L	L	L	H	$
*	$	H	h	h	h	h	L	H	$
*	$	H	h	h	L	h	L	H	$
	$	H	h	h	L	L	L	H	$

Bounded Tone Spreading

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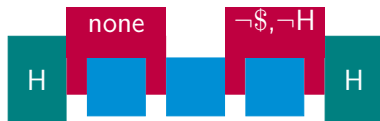H spreads all the way to the right edge,...
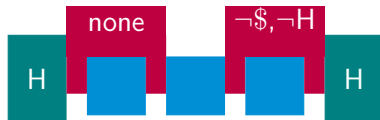
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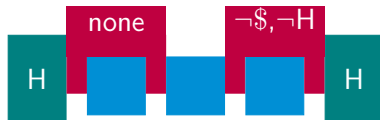
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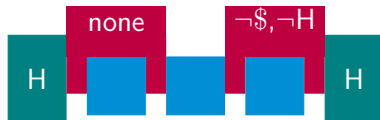
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* $ H h h L h L H $
  $ H h h L L L H $

16

Bounded Tone Spreading

1 **Unbounded Tone Spreading in Copper Belt Bemba...**
H spreads all the way to the right edge,...
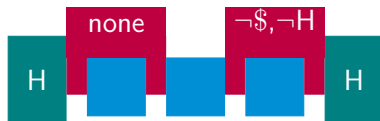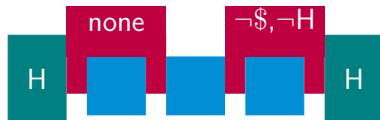
2 **...With a Non-Local Inhibitor**
...but only 2 syllables if there is an H later on.

*LXX
*XLX
*hhh

(X ∈ {H,L,h})

* \$ H L L L L L H \$
* \$ H h L L L L H \$
* \$ H h h h h L H \$
* \$ H h h L h L H \$
  \$ H h h L L L H \$

16

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16

Danger, Will Robinson! Overgeneration!

- ▶ IBSP needs more fine-grained intervals.
- ▶ But this easily leads to typological overgeneration.

Danger, Will Robinson! Overgeneration!

- ▸ IBSP needs more fine-grained intervals.
- ▸ But this easily leads to typological overgeneration.

    *sʃ
    *ʃs

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Danger, Will Robinson! Overgeneration!

- ▶ IBSP needs more fine-grained intervals.
- ▶ But this easily leads to typological overgeneration.

- ▶ This produces **First-Last harmony (FLH)**,
  which is **unattested**.

Proposal: k-Vals Must be c-Command-Like

- ▶ What separates FLH from the attested cases?
- ▶ k-val for FLH relaxes locality, then tightens it again (local + non-local + local)
- ▶ Attested cases are of the form
    - ▶ local + non-local, or
    - ▶ non-local + local
- ▶ This is similar to **c-command**.

c-Command as Local + Non-Local

x c-commands y (in a strictly binary branching tree) iff

local x has a sister z, and

non-local z reflexively dominates y.

Deepening the Connnection: Monotonicity

Ban On Improper Locality

Within a k-val, the degree of locality must be

- ▶ monotonically increasing, or
- ▶ monotonically decreasing.

- ▶ **Monotonicity in syntax**
  - ▶ Subcategorization $<$ A-Move $<$ A$'$-Move
  - ▶ Once you've undergone a higher operation,
    you can't participate in lower ones anymore.

- ▶ **Monotonicity in morphology**
  - ▶ *ABA follows from monotonicity.

- ▶ **Monotonicity in semantics**
  - ▶ Everywhere. . .

Summary

- ▶ SP bans subsequences $\Rightarrow$ no locality at all
- ▶ Adding locality domains to SP greatly increases its power.
- ▶ But IBSP with simple k-vals is still too weak.
- ▶ Adding c-command-like locality domains
  - ▶ grants enough expressivity
  - ▶ while avoiding overgeneration.

Main Predictions

- ▶ *local + non-local + local (*LNL)
  No unbounded dependency between local "clusters"
- ▶ *non-local + local + non-local (*NLN)
  No local "cluster" within interval dependency

Next Steps

1. Test the predictions against the full typology.
   *NC···NC (Blust 2012; thanks to Adam Jardine)
2. Explore the syntax column.
3. Go beyond monotonicity in deriving the limitation.

References I

Applegate, Richard B. 1972. *Ineseño Chumash grammar*. Doctoral Dissertation, University of California, Berkeley.

Baek, Hyunah. 2017. Computational representation of unbounded stress: Tiers with structural features. Ms., Stony Brook University; to appear in *Proceedings of CLS 53*.

Bickmore, Lee S., and Nancy C. Kula. 2013. Ternary spreading and the OCP in Copperbelt Bemba. *Studies in African Linguistics* 42.

Blust, Robert. 2012. One mark per word? some patterns of dissimilation in Austronesian and Australian languages. *Phonology* 29:355–381.

Chandlee, Jane. 2014. *Strictly local phonological processes*. Doctoral Dissertation, University of Delaware. URL http://udspace.udel.edu/handle/19716/13374.

Graf, Thomas. 2017. The power of locality domains in phonology. *Phonology* 34:1–21. URL https://dx.doi.org/10.1017/S0952675717000197, in press.

Hayes, Bruce. 1995. *Metrical stress theory*. Chicago: Chicago University Press.

Heinz, Jeffrey. 2009. On the role of locality in learning stress patterns. *Phonology* 26:303–351. URL https://doi.org/10.1017/S0952675709990145.

Heinz, Jeffrey. 2010. Learning long-distance phonotactics. *Linguistic Inquiry* 41:623–661. URL http://dx.doi.org/10.1162/LING_a_00015.

References II

Heinz, Jeffrey, Chetan Rawal, and Herbert G. Tanner. 2011. Tier-based strictly local constraints in phonology. In *Proceedings of the 49th Annual Meeting of the Association for Computational Linguistics*, 58–64. URL `http://www.aclweb.org/anthology/P11-2011`.

Hyman, Larry. 2011. Tone: Is it different? In *The blackwell handbook of phonological theory*, ed. John A. Godlsmith, Jason Riggle, and Alan C. L. Yu, 197–238. Wiley.

Jardine, Adam. 2016. Computationally, tone is different. *Phonology* 33:247–283. URL `https://doi.org/10.1017/S0952675716000129`.

McMullin, Kevin. 2016. *Tier-based locality in long-distance phonotactics: Learnability and typology*. Doctoral Dissertation, Uniersity of British Columbia.

Stanton, Juliet. 2016. Latin *-alis*/*-aris* and segmental blocking in dissimilation. Ms., MIT.